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diate returns, and attend very carefully to the details of packing and shipping. Even when these conditions are met, the opportunities for foreign trade are slow in developing. The people are poor, unambitious, and content with their lot. Any campaign of trade here must be primarily one of education.

COL. ROOSEVELT'S EXPLORATION OF A TRIBUTARY OF THE MADEIRA

Col. Roosevelt's lecture before the National Geographic Society of Washington on May 26, as reported in full in the *New York Times* of the following day, affords the first general account of his recent descent of a hitherto unknown tributary of the Madeira. The narrative of his trip across South America which is appearing in *Scribner's Magazine*¹ has, in the last number available, only progressed as far as São Luiz de Cáceres (16° S.) on the upper Paraguay and, therefore, does not include this part of his journey.

Although not intending to undertake original exploration, Col. Roosevelt, prior to his departure for South America, had already decided to return, not by the conventional trip by sea along the west coast but, instead, by crossing the continent from south to north. From Buenos Aires he planned to ascend the Paraná and Paraguay Rivers and cross over into the Amazon basin. On hearing of his plans in Rio de Janeiro, Dr. Lauro Müller, Minister of Foreign Affairs of Brazil, made arrangements to have Col. Roosevelt met at the Brazilian frontier by a colonel of the Brazilian army, who was to accompany him over the divide to the headwaters of the river selected for the descent into the Amazon basin and probably go with him for the whole distance. The selection of the tributary of the Amazon to be followed was determined by a possibility which Dr. Müller pointed out to Col. Roosevelt. Col. Candido Mariano da Silva Rondon, the officer delegated to accompany Col. Roosevelt, had for years been engaged in exploring the ill-known highlands of Matto Grosso. In 1907 he had been sent by the Brazilian government to explore the region on the divide between the headwaters of the Madeira and the Tapajoz and to construct a telegraph line to the rubber settlements on the Madeira. On this occasion he and his assistants surveyed for the first time the Gy-Paraná and the Juruena, the former an important tributary of the Madeira, the latter, of the Tapajoz. A couple of days' march northwestward from a station he established on the divide between the Gy-Paraná and the Juruena, which he named José Bonifacio, he, in 1909, came across the headwaters of a river running northward between

¹ Theodore Roosevelt: A Hunter-Naturalist in the Brazilian Wilderness, *Scribner's Magazine*, Vol. 55, 1914, pp. 407-435, 539-558 and 667-689.

these two river systems.² As to where it debouched, he could only guess, although he believed it emptied into the Madeira. As all inferences with regard to its course were mere conjectures he entered it on his sketch maps as the Rio da Dúvida, or the River of Doubt. It was the possibility of following this river to its mouth that Dr. Müller suggested, a proposal which Col. Roosevelt gladly accepted.

The expedition as constituted at the outset of this trip consisted of two parts, the members of Col. Roosevelt's party and the assistants of Col. Rondon. The expedition was officially designated, after its leaders, "Expedição Científica Roosevelt-Rondon." The Roosevelt party included: Kermit Roosevelt, Col. Roosevelt's son; George K. Cherrie, ornithologist, and Leo E. Miller, mammalogist, representing the American Museum of Natural History of New York City; Anthony Fiala, best known as commander of the second Ziegler polar expedition of 1903-05, who had charge of the equipment; Father Zahm, late of Notre Dame University, Indiana; Frank Harper, Col. Roosevelt's secretary; and Jacob Sigg, hospital nurse and cook. Col. Rondon's companions included Captain Amílcar de Magalhães; Lieutenants João Lyra, Julio Barbosa, Thomas Reis, Joaquim de Mello and Alcides de Sant' Anna; Dr. Euzebio de Oliveira, assistant geologist of the Serviço Geologico e Mineralogico do Brasil; Frederico Hoehne, botanist; and two assistant taxidermists. Frank Harper went only as far as Tapirapoan (14½° S.), while Father Zahm and Jacob Sigg accompanied the expedition to Utiarity (13° S., see below).^{2a} The party which descended the unknown tributary of the Madeira finally consisted only of Col. Roosevelt, Col. Rondon, Kermit Roosevelt, Cherrie, Lieut. Lyra and Dr. Cajazeira, a Brazilian physician, besides sixteen men. Fiala reached the Amazon via the Juruena and the Tapajoz, while Miller, Lieut. de Mello, Dr. de Oliveira and one of the taxidermists descended the Gy-Paraná and the Madeira.^{2a}

On January 5, 1914, the expedition had reached São Luiz de Cáceres on the upper Paraguay. From here to the headwaters of the newly explored river the route of the party can not be given with definiteness inasmuch as the two sources cited above leave a gap with regard to this part of the journey. At all events, the party traveled by mule and ox-train in a northerly and then in a northwesterly direction across the highland region which carries the Amazon-Paraná divide, at first following up the Rio Sapotuba, near the head of which the party reached Tapirapoan on January 16. At Utiarity, in 13° S. on the Papagaio, one of the source-streams of the Juruena, the party, it seems, divided

² An account of these explorations, by H. Wichmann, based on the original which appeared in the Dec. 24, 1909, Jan. 15 and Feb. 27, 1910, issues of the *Jornal do Commercio*, a daily newspaper of Rio de Janeiro, and entitled "Col. Candido Rondon's Expedition im brasilischen Hinterlande" will be found in *Petermanns Mitteilungen*, Vol. 56, I, 1910, pp. 260-261. It is accompanied by a map (Taf. 47) on the scale of 1:7,500,000, which shows, in red, the hydrography of the entire region between the headwaters of the Paraguay and the upper Madeira as resulting from Col. Rondon's surveys, superimposed over the drainage system of the region according to the prevailing conception, shown in black. This striking comparison shows that hardly a river in this extensive tract flows where it was supposed to. The greatest discrepancies relate to the Gy-Paraná and the Juary. The upper course of the former lies nearly a degree and a half farther west than supposed, a fact to which Col. Roosevelt called attention in his lecture; while the latter in its entirety bears no resemblance whatsoever to its counterpart on existing maps. Instead of rising in 12° S. and 61° W. and flowing northwest, it rises in 11° S. and 64° W. and flows north. On the accompanying map the drainage of this whole region is based on Col. Rondon's surveys.

^{2a} Information kindly furnished by Dr. Frank M. Chapman, of the American Museum of Natural History.

into the three groups which were each to reach the Amazon by a different route. The Roosevelt-Rondon party in due course came upon the headwaters of the "Rio da Dúvida." On February 27(?), in 12°1' S. and 60°18' W., they embarked on this river, which was to carry them northward into the Madeira.

The general course of this hitherto unknown affluent of the Madeira is given as follows (allowance is made for the discrepancies occurring in the newspaper version of Col. Roosevelt's lecture in Washington): It rises in the highland of western Matto Grosso just north of 13° S. and between 59° and 60° W. at an elevation about 1,000 feet above its mouth (at its confluence the Madeira is about 85 feet above sea level). In its upper course it flows first west and then south, and finally north³—a mountainous, timber-choked brook. It is not navigable above the point where the party embarked, which is about 180 miles downstream from its source. From here it flows north for its entire length between the 60th and 61st meridians, approaching the latter most closely in 8°15' S. It empties into the Madeira in 5°30' S. From about 11°45' S. to 10°45' the river is an almost unbroken series of rapids. Two are designated by name: the first encountered were at Navarite in 11°44' S.; those met with in 11°12' S. were named Peishan Rapids. Below the last rapids (10°45'?) the river flows smoothly and has considerable volume. At the junction with the so-called upper Aripuana a volume of 4,500 cubic meters (159,000 cubic feet) per second was measured. This would be more than the mean annual discharge of the Hoang-ho or the Indus and more than three times that of the Rhine.⁴ The following tributaries entered the main stream: in 11°23', the Rio Kermít from the left; in 11°22', the Marcian Avila from the right; in 11°18', the Taunay from the left; in 10°58', the Cardoza from the right; in 9°38', the Rio Branco from the left; and, finally, from the left, in 7°34', the Aripuana, which is practically of the same size as the main stream. The estimated length of the river from source to mouth, including sinuosities, is 1,400 to 1,500 kilometers (870 to 930 miles). This would make it somewhat longer than the Rhine and somewhat shorter than the Ohio. The astronomical observations on which these positions are based were made by Lieut. Lyra. Readings were taken at about every half degree or every degree of latitude.

The whole journey from the point of embarkation to the mouth, which was reached about April 30, took about 62 days. During the first four days (Feb. 27-Mar. 4?) the river was slowly descended to 11°45', and a careful survey of this section of its course was made. The journey from here, where the first rapids were encountered, to 10°45', where the rapids seem to have ended, consumed 42 days (Mar. 4 to Apr. 15?). Two days later, on April 17(?), the uppermost camp of the rubber men was reached in 10°24', and eleven days later (Apr. 28?), in 7°15', the party was met by Lieut. Pyrineus⁵ on the steamer which Col. Rondon had previously directed him to take up the Ari-

³ On the map in *Petermanns Mittheilungen* the headwaters of the "Rio da Dúvida" (referred to in the text as the Rio Doze de Outubro, probably from the date of its discovery in 1909) are represented as on the accompanying map. This does not quite tally with the course as here described.

⁴ (Sir) John Murray: On the Total Annual Rainfall on the Land of the Globe, and the Relation of Rainfall to the Annual Discharge of Rivers, *Scott. Geogr. Mag.*, Vol. 3, 1887, pp. 66-77, specifically Table VI, on p. 76.

⁵ Probably the same, who, on Col. Rondon's expedition of 1900, explored the Rio Jaru, or Tramaco, a left tributary of the Gy-Paraná. In the account of Col. Roosevelt's lecture his name is spelled "Pyrinez."

puana on the assumption that this would prove to be the lower course of the river they were to follow. On this steamer the party descended the river to its mouth, and then proceeded down the Madeira and up the Amazon to Manáos, which was reached about May 1.

The trip was attended by no inconsiderable hardships. Of the seven dug-out canoes in which the party started, five were lost in the rapids, and of the three others which were then built, one was wrecked. One of the native paddlers was drowned. Under the strain of the trip another man went mad, shirked all his work, stole his comrades' food, and, on being punished, murdered his superior (Sergeant Peishan, after whom one of the rapids was named), and fled into the wilderness. Col. Roosevelt himself suffered an injury to his leg when his canoe upset. Col. Rondon had a narrow escape from death. While hunting monkeys for food, his dog, which preceded him, was killed by Indians, whose arrows would probably otherwise have struck him, had he not been warned of their presence by the dog's cry. The arduous trip down the rapid-interrupted stretch of the river told heavily on the party's food supply: at the end of this stage of the journey they had used up about three-fourths or four-fifths of their rations, although only about one-sixth of the distance had been covered. Fortunately, at the rubber camp which was reached two days later, some food was procured—sugar-cane, rice and bananas. Conditions were such that everything not absolutely necessary had to be discarded: personal belongings were reduced to the clothes on each man's back, with a spare set of underwear. Even part of the medicine was thrown away. Of the instruments only those needed for the determination of positions were kept.

The geographical results of the trip are of no mean value. In the first place a tributary of the Madeira, hitherto unknown in its entirety, was traced from source to mouth. Col. Roosevelt in his lecture makes it plain that its lower course was known to the rubber men, although it had never been surveyed and was not correctly represented on existing maps. The reference in the lecture to Lieut. Pyrineus's meeting the party coming down, after he had ascended the river known, at its confluence with the Madeira, as the Aripuana, seems to indicate that it is this river which coincides with the lower course of the new river. The Aripuana, however, joins the Madeira in 5°7' S. according to the standard map of the latter.⁶ The mouth of the new river is given by Col. Roosevelt as lying in 5°30'. This position would more closely correspond with the mouth of the Maturá River, which debouches into the Madeira in 5°28½'. On large-scale maps of the region⁷ both the Maturá and the Aripuana are shown to be rivers of considerable length rising to the south, so that from this point of view both could come into consideration. Identification is further complicated by references in the lecture to a "so-called upper Aripuana" and to a "Castanha branch." With regard to the former the

⁶ The Madeira River from its Mouth to the Falls of San Antonio. Surveyed by Comdr. T. O. Selfridge and the officers of the U. S. Ship *Enterprise*, June and July, 1878. [1:100,000.] In 5 sheets. U. S. Hydrographic Office Charts Nos. 893-897. Washington, 1882.

⁷ e. g.: Mappa Geographico do Estado do Amazonas. Organizado por Ermanno Stradelli de accordo com suas notas e explorações e baseado nos melhores mappas. 1:2,222,000. V. Porta, Piacenza, Italy, 1901. (The bibliographical list printed on this map indicates a knowledge of the sources which inspires confidence in its reliability.)

Estado do Amazonas: Mappa organizado por Ermanno Stradelli e publicado na administração do Ex^{mo}. Senhor Dr. A. Constantino Nery. 1:1,111,000. 1ª Edição. Aillaud & C^a, 1906. (Wall map).

impression received is that the new river, although the main stream, has locally been interpreted as a branch of the Aripuana and that the name Aripuana is applied both to the tributary entering the new river from the left in $7^{\circ}34'$ and to the new river below this confluence. But this matter as well as all questions concerning the definite location of the new river cannot be settled until the appearance of a map showing its course.

All conjectures as to the hydrography of the region between the Madeira and the Tapajoz, which are based on existing maps, must prove misleading. Although the majority of standard and official maps⁸ indicate a comprehensive hydrographic system in this region, they are based, as a competent critic has well observed, "in spite of their copious nomenclature and the inextricable network of their river systems, only on the vaguest data."⁹ Col. Rondon's surveys in the Gy-Paraná region, with their sometimes almost complete reversal of previous conceptions as to the drainage system, are an excellent illustration of this. Of all the river courses figuring on the maps between the Madeira and the Tapajoz, only the Canumá, Abacaxis and Maué-assú are based on surveys of any kind,¹⁰ and of these the southernmost (that of the Abacaxis) does not extend much further south than 6° S. The Roosevelt-Rondon expedition has, therefore, made a major contribution towards solving the problem of the hydrography of the region. We now know definitely in the area under discussion the position of the Gy-Paraná in the southwest, of the new river running meridionally through the whole area from south to north, and of the Abacaxis in the north. This makes it highly probable that the new river, as Col. Roosevelt has stated, is the longest affluent of the Madeira.¹¹ The unexplored area left between the Gy-Paraná and Madeira on the west and the new river on the east can hardly harbor a larger river system, inasmuch as its longest axis measures about 400 miles as against an extension of the new river over $7\frac{1}{2}^{\circ}$ of latitude, or over 500 miles. This does not even take into account the possibility that the tributaries, within this area, of the Gy-Paraná and of the new river, in view of the size of these two river systems, may approach each other so closely (the mean distance between the Gy-Paraná and the new river is 120-150 miles) as not to allow of the development of an inter-

⁸ *e. g.*: Maps of the states of Amazonas and Matto Grosso, on the scale of 1:6,200,000 approximately, constituting Pls. III and XXIII, respectively, of the "Atlas do Imperio do Brazil . . . organizado per Candido Mendes de Almeida," Rio de Janeiro, 1868; with bibliography in the text on pp. 10-11 and 30-32.

Carta do Imperio do Brasil. Organizada pela Comissão da Carta Geral sob a presidencie do General Henrique de Beaurepaire Rohan, com a coadjuvação do Exmo. Sñr. Barão Da Ponte Ribeiro. 1:3,710,220. 1875.

Mappa Geral da Republica dos Estados Unidos do Brasil. Publicado por occasião da Exposição Nacional de 1908 por ordem do Exmo. Sñr. Ministro da Industria, Viação e Obras Publicas, Dr. Miguel Calmon Du Pin e Almeida. 1:5,000,000.

Mappa da Viação Ferrea do Brazil e suas ligações com as rêdes ferreas de Bolivia, Perú, e Republicas do Prata, de accordo com os ultimos documentos e mappas geographicos em 1911. Organizado pelo Engenheiro Emilio Schnoor para a Companhia E. F. Victoria à Minas. 1:5,000,000.

⁹ F. Schrader in the bibliographical notice, dated 1894, accompanying Sheet 84 (Amérique du Sud: Flle. N. E., 1:6,000,000) of the "Atlas Universel de Géographie," Hachette et Cie., Paris.

¹⁰ By W. Chandless, in 1868: see his "Notes on the Rivers Maué-assú, Abacaxis, and Canumá," with map, 1:1,000,000, *Journ. Roy. Geogr. Soc.*, Vol. 40, 1870, pp. 419-432.

¹¹ Previously the Gy-Paraná was so to be considered—a status that only dated, however, from Col. Rondon's expedition of 1909. The Mamoré, Guaporé, and Beni are not tributaries, but source-streams of the Madeira.

vening stream of any proportion. Between the new river and the Tapajoz this contingency seems more possible, if alone the size of the intervening area be considered, which is about 550 by 180 miles. This includes the drainage area of the Abacaxis; but according to Chandless's account it is highly improbable that this river should take its source as far south as the upland of Matto Grosso, inasmuch as at the mouth of the Arapady, in lat. $6^{\circ}12'$ —as far as Chandless ascended—, it was a very small stream with the boughs of the trees on its banks joining overhead.¹² The Canumá, because of its greater volume, might more easily drain the intervening region: indeed it is this river which, on the majority of recent maps, is represented as the most important drainage channel between the Madeira and the Tapajoz, a fact which led one of Col. Roosevelt's critics to suggest that he had descended this river. But even should it, when explored, prove to be longer than the new river (although indicated on these maps as rising as far south as 9° S., it has never been surveyed above the highest point attained by Chandless in 1868, at the junction, in $5^{\circ}17'$, with the Secundury, by which name the main stream is known above this point), it might be argued that the Canumá is not a tributary of the Madeira, inasmuch as it empties only into a *furo*, a backwater, which connects the Madeira with the Amazon. To summarize, therefore: the Roosevelt-Rondon expedition is the first, since Chandless, to give us any definite knowledge as to the hydrography of the area between the Gy-Paraná-Madeira and the Tapajoz, and it seems probable that the newly discovered river is the major drainage artery of that region. Incidentally the expedition has shown that the drainage divide designated "Cordilheira do Norte" on recent maps, which was supposed to extend from the Serra dos Parecis in $60\frac{1}{3}^{\circ}$ W. north-northeast between the headwaters of the Gy-Paraná and the Canumá on the one hand and the Tapajoz on the other, and whose existence made other premature critics skeptical as to the route of the party, lies farther east and forms the divide between the headwaters of the new river and the Juruena.

A question of geographical interest connected with the expedition is the location of the lowest rapids on the new river. The report of the Col. Roosevelt's lecture in Washington seems to indicate that these lie in $10^{\circ}45'$ S., although it is not quite clear whether this position refers only to the end of the especially turbulent stretch of the river, which it took forty-two days to descend, or whether it indicates the last of all the rapids. The point is of interest, because, wherever these lowest rapids may lie, they represent a natural boundary. The route of the expedition led through two of the major natural regions of South America, the Brazilian Highlands and the Amazon Lowlands. The Brazilian Highlands, which occupy the whole eastern part of the continent to the east of the Amazon and Paraná-Paraguay lowlands, are an upland area composed of geologically ancient rocks whose varying degree of hardness has given rise to numerous rapids in the rivers which flow over them. On the contrary, the Amazon Lowland is a vast depression whose extremely low gradient (300 ft. in 2,500 miles) makes for the development of quiet, sluggish rivers. The boundary between these two regions is indicated by the final falls and rapids which occur on the southern tributaries of the Amazon where they flow over the margin of the upland into the lowland. On the lower tributaries these rapids lie near their mouths, but, as one proceeds to the west, they lie increasingly farther upstream. Thus, on the Xingú they lie in 3° S.; on the Tocan-

¹² *op. cit.*, p. 423.

tins, in 4° ; on the Tapajoz, in $4\frac{1}{2}^{\circ}$; on the Maué-assú, in 5° ; on the Canumá, probably in 6° ; while on the Madeira they are in $8\frac{3}{4}^{\circ}$ S. If on the new river they should lie in $10\frac{3}{4}^{\circ}$ S. this would indicate an embayment of considerable magnitude in the Amazon Lowland extending into the Brazilian Highlands at this point.

For all other results of geographical interest we must await the reports of the various members of the expedition. Col. Roosevelt's narrative in *Scribner's Magazine* will probably, as it progresses, furnish additional details, as may his lecture before the Royal Geographical Society in London on June 16. The matter of greatest moment, of course, is a map of the new river: and it is to be hoped that one will soon be published on the basis of Lieut. Lyra's observations. The Serviço Geológico e Mineralógico do Brasil will probably publish Dr. de Oliveira's notes on the geology of the region he traversed—from a geographical standpoint it might be regretted that he was unable to accompany the party which descended the new river—; and botanical results may be forthcoming from Senhor Hoehne. The zoological results of the expedition will doubtless prove to be particularly valuable in view of the fact that the study of faunal life was one of its main objects. Geographically they will probably be of more than usual interest, as, in keeping with Col. Roosevelt's known views on the methodology of natural history, they may be expected to lay stress on the ecological rather than on the taxonomic phase of the subject. The Roosevelt-Rondon expedition has thus, it will be seen, made valuable contributions to our knowledge of a little known section of the earth's surface. Aside from their interest in the expedition as bearing upon their field of work, geographers, above all, can appreciate Col. Roosevelt's feeling of gratification at having been able to participate in original exploration—"a chance," to use his own words, "that from now on, in the present state of the world's geography, can only come to a limited number of men."

W. L. G. J.